Chapter 10
Remote Delivery of Video Services over Video Links

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ABSTRACT

The spreading of new systems of broadcasting and distribution of multimedia content has had as a consequence a larger need for aggregation of data and metadata to traditionally based contents of video and audio supply. Broadcasting chains of this type of channels have become overwhelmed by the quantity of resources, infrastructures, and development needed for these channels to provide information. In order to avoid this kind of shortcoming, several recommendations and standards have been created to exchange metadata between production and distribution of taped programs. The problem lies in live programs; producers sometimes offer data to channels, but most often, channels are not able to face required developments. The key to this problem is cost reduction. In this work, a study is conducted on added services which producers may provide to the media about content; a system is found by which additional communication expenses are not made, and a model of information transfer is offered which allows low cost developments to supply new media platforms.

INTRODUCTION

The model change which Digital Terrestrial Television (DTT) is causing, IP-based television in all its forms or simply diffusion on Internet is provoking on one hand, that traditional broadcast companies look for new markets with new technologies and on the other hand, other companies have started to broadcast material by these new means with only having rights and not necessarily licenses, as in the case of broadcasting.

The proliferation of chains and transmission channels have consequently put into motion, as a consequence, the abandoning of productions, and

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concentration on transmission itself while at the same time, companies specialized in production have emerged which generate cheaper content and which can be commercialized on different supports.

Audiovisual contents which are generated are sent to different clients by two clearly differentiated types of transmission:

- Delivery in real time (live programs). The video material is coded in MPEG2 Transport Stream for its transfer to the destination by a data link. On the other end of the link it is connected to a decoder to decode the data stream on base band.
- Delivery in a file or tape (recorded or taped). By this means of delivery, the edited file is sent by disk or tape to transmitting stations.

Production companies have the data; they are experts in each of the subjects they produce. For data and metadata interchange of taped programs, different standards and recommendations exist, the problem arises in data exchange for live programs in which channels have to adapt their applications or create new ones to be able to give service to viewers.

In this work, the need to create a standard of data service on distribution networks of live programs will be presented based on the following principles:

- The producer of the event generates data, because he best knows the content of the broadcasting.
- Data on XML documents for a better adaptation to existing technologies. This data exchange facilitates creation of new applications.
- Data delivery on the same video networks, so that data go tightly connected to the signal itself with the consequent saving in communications.

In this chapter, technological aspects related to the work presented are reviewed. The main objective is to show an analysis of services which can be offered from producers to broadcaster, and to present solutions to these services. We finished with the models which differ from the general model in order to adapt special services and the solutions are discussed in more depth, and we include conclusions as well as mention of future work to be developed.

BACKGROUND (PRODUCTION ISSUES)

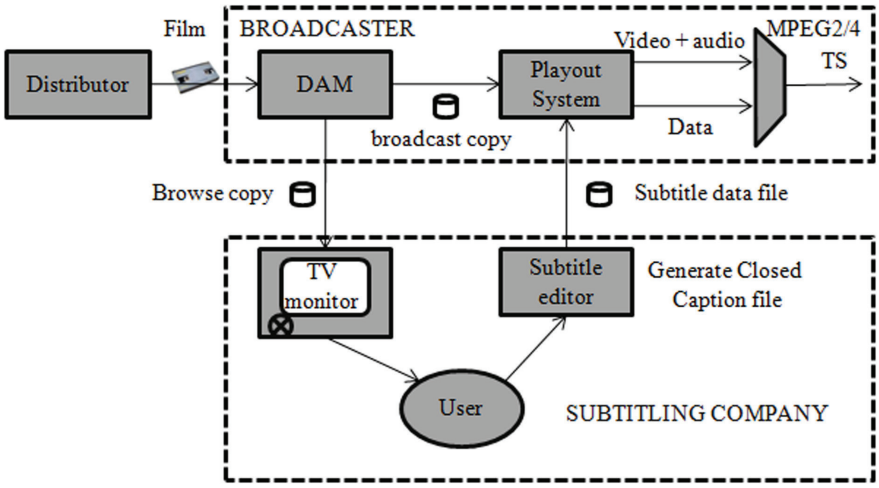
In this section we will review some aspects in the professional video production.

Data Exchange

What are metadata? Metadata provide information about data content. Literally, metadata are data further than data, and characterize the content by a group of attributes. These attributes may not only describe content in the form of raw data, meaning, and/or key concepts, content is also characterized in terms of author, quality, production time, format, etc. Also, added information during delivery service (such as receipt information) or information about permits for use of content must be correctly described by metadata. In short, metadata (referring to multimedia/audiovisual content) contain information about all related aspects to the entire chain of content provision.

The fact that audiovisual content has associated metadata offers many advantages. One of the main ones is to be able to make searches for content in a very intense way. Due to the great quantity of information metadata contain, very complex and varied searches may be carried out: by author, description, permits, etc. Another advantage is the ease of content exchange or distribution, since metadata are associated with content, distribution or exchange information is

Figure 1. Subtitling workflow



incorporated. Content classification is made easier for storage, for example, perhaps a certain kind of content should be stored in a concrete format so as not to lose quality, while other types of content may be less important. Upon broadcasting, if one does not have rights, this will avoid violation of broadcasting rights.

On several occasions, there has been an effort to standardize the storage process of audiovisual data: for example, code ISAN **(ISO, 2004)** and code VISAN **(ISO, 2002)**; technical reports collected by the EBU (European Broadcasting Union) in its projects: TV-Anytime **(Evain, 2000)**, ESCORT **(EBU, 2007)** or P/META **(EBU, 2005)**; the BBC data model SMEF **(BBC Technology, 2003)**; Dublin-Core **(DublinCore, 2003)**, etc. Many of these proposals have been worked on in parallel and a common representation has still not been reached of this knowledge. On the other hand, each organization has its internal needs of storing certain types of information, needing an effective and efficient data model according to its specific needs.

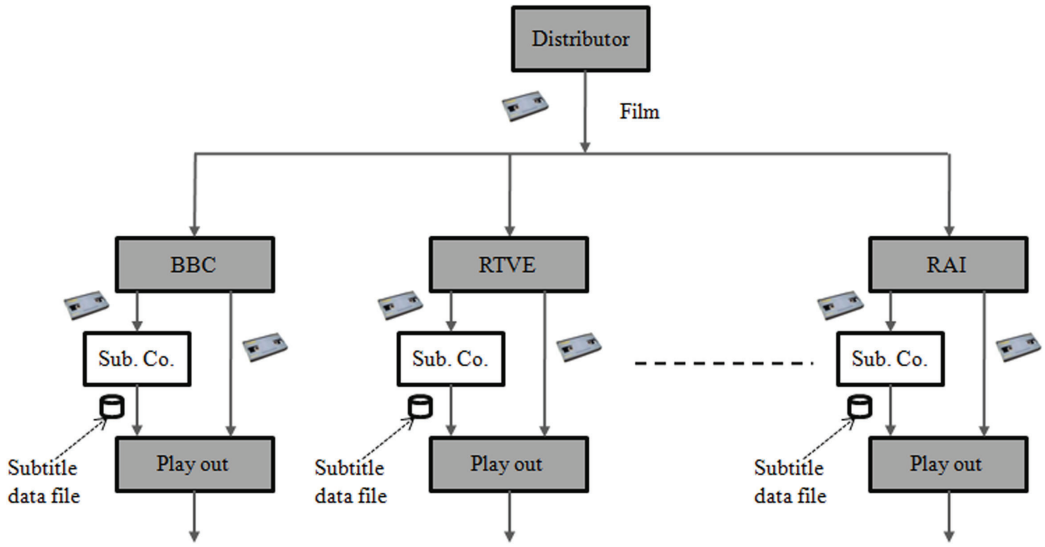
Subtitling

Subtitling is used extensively by television channels to attract public with hearing impairment, viewers who want to learn a language or simply to be able to understand dialog of an event with original sound (e.g. opera).

At present, distributors send tapes or discs with series content. This content is usually video material and two audios: original sound and natural. Original sound is that corresponding to dialog in the language of the film while natural is the rest of the sounds different from dialog, this way dubbing companies change the original sound with that of each country. When channels receive material from the distributors, they send a copy of video with low quality to companies specializing in subtitling. These formats integrate the broadcasting system in such a way that audio and video are synchronized with subtitle information, as can be seen in Figure 1.

As can be observed in Figure 2, copies of the film are distributed in each country to companies who have the rights; these companies send a copy to subtitling companies sending a file so that the broadcasting system of the channels incorporates

Figure 2. Content distribution



this information for diffusion. Two types of subtitles are defined as such:

- Dialog subtitling. This is done so that viewers can see the dialog in the language of the country where the original sound is heard. In the
- Emission, the text forms part of the image and cannot be changed, commands may be sent to change typography.
- Subtitling for the deaf (closed caption). In contrast to the above, the text does not form part of the image and is shown on the same receptor as the viewer desires. It is closely linked to data transmission in the same video signal.

The arrival of the MPEG compression format has allowed greater possibilities and larger bandwidths to transmit data than analog transmission, this transmission being limited by bandwidth of the vertical deletion lines.

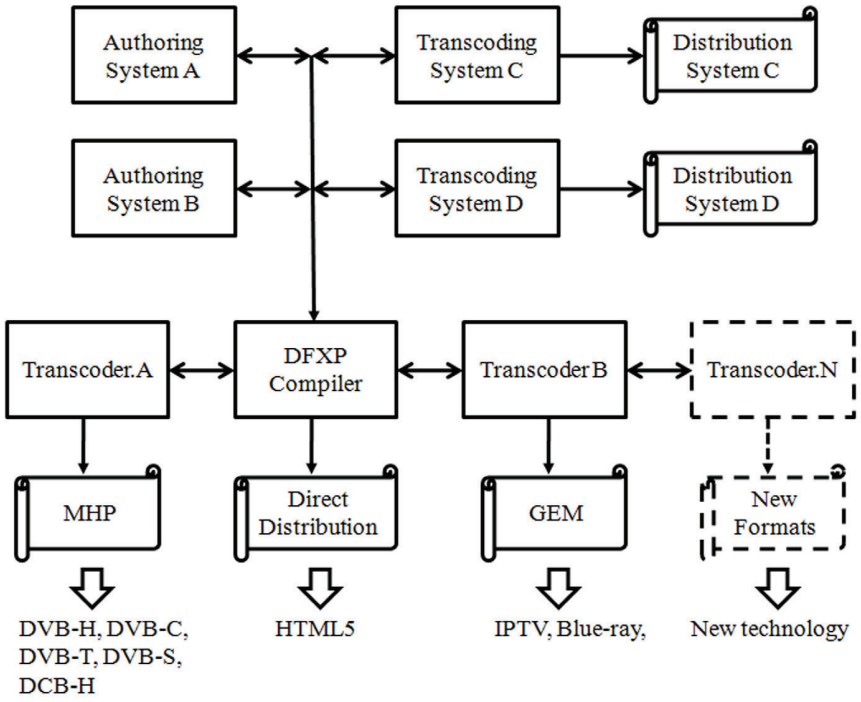
The subtitling regulation **(ETSI, 1997)** specifies how regions, colours, formats etc are to be transmitted in the different transmission forms: DVB-T, DVB-S, DVB-C and DVB-H (terrestrial, satellite, cable and mobile). An exhaustive review of all these can be found in **(Reimers, 2006)**.

Distribution Format Exchange Profile (DFXP)

Currently, EBU has adopted the Timed Text (TT) Authoring Format 1.0 – Distribution Format Exchange Profile (DFXP) **(W3C, 2010)** and has created a working group for use the standard DFXP for exchange subtitling information in XML.

The timed text authoring format is a content type that represents timed text media for the purpose of interchange among authoring systems. Timed text is textual information that is associated with timing information, it serves as a bidirectional interchange format among a heterogeneous collection of authoring systems, and as a unidirectional interchange format to a heterogeneous collection of distribution formats after transcoding or compilation to the target distribution formats as required, and where one particular distribution format is DFXP. Authoring users produces, exchange data, transcode information to different

Figure 3. DFXP workflow



formats and compile to DXFP for distribution to DXFP clients or transcoding to other formats as see in Figure 3.

In the figure it can be see how there are several authority systems (two in the figure) working in collaborative systems. Data can be trascode do other formats (System C or System D), at the same time, data can be compiled as DFXP document for direct distribution or transcoding to other formats as Multimedia Home Platform (MHP), Global Executable MHP (GEM) for IPVT chains or future formats.

A DFXP document contains a header and a body. Header specifies document level metadata, styling definitions and layout definitions; body specifies text content intermixed with references to style and layout information and inline timing information. In Box 1 there is an example with DFXP structure, where the head contains the metadata, styling, layout definitions and the body.

The body part performs as a container for a sequence of textual content units represented as logical divisions (see Box 2).

A simple example of content is shown in Box 3.

Where a subtitle "How are you?" is presented in the image between seconds 5" and 7" when the picture file associated with the subtitle are played. The standard provides more fields in order to indicate other characteristics about the subtitle (position, color, font, etc.).

The text to be displayed is within a "P" element in the DFXP metamodel. A "P" element represents a logical paragraph, serving as a transition between block level and inline level formatting semantics and it has his corresponding identification attribute. This attribute will be used to link original subtitle format and text to the corresponding translated text. There are also two important attributes: begin and duration. The XML structure of a "P" element is shown in Figure 4.

Box 1.

```
<tt xml:lang="" xmlns="http://www.w3.org/2006/10/ttaf1">
  <head>
     <metadata/>
     <styling/>
     <layout/>
  </head>
  <body/>
</tt>
```

Box 2.

```
<body
  begin = <timeExpression>
  dur = <timeExpression>
  end = <timeExpression>
  region = IDREF
  style = IDREFS
  timeContainer = (par|seq)
  xml:id = ID
  xml:lang = string
  xml:space = (default|preserve)
  {any attribute in TT Metadata namespace}
  {any attribute in TT Style namespace}
  {any attribute not in default or any TT namespace}>
  Content: Metadata.class*, Animation.class*, div*
</body>
```

Box 3.

```
<body region="subtitleArea">
  <div>
    <p xml:id="subt1" begin="5s" end="7s">
      How are you?
    </p></div>
</body>
```

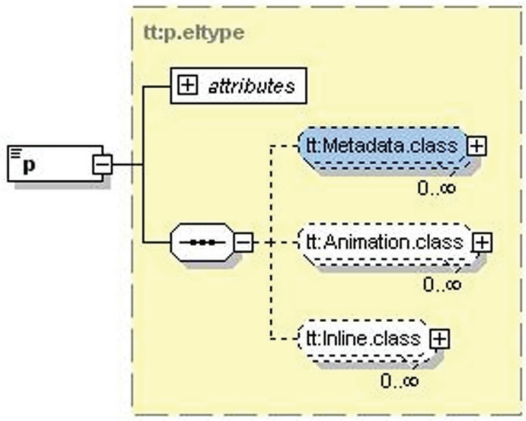
Begin and duration attributes are time expressions that can be a clock time or an offset. The span of time a subtitle is about to be displayed is included in the original file as offset time expressions, setting the begin value to an estimate time and the duration attribute to the corresponding offset (usually, only few seconds more).

Live Programs

As mentioned above, producers usually make programs for different chains, not only stored programs but also live programs. Clear examples are international sports events, where from a source station images are sent to different chains or broadcasting companies as is shown in Figure 5. Chains lower the signal (normally satellite) to place content in the emission system for its packeting and emission playout. Each of the channels has to adapt the signal arriving to the broadcasting format for which it has acquired the rights to that event.

A Playout control room can be show in Figure 6 where all audiovisual material is put on air in the appropriate order.

Figure 4. XML structure of a "P" element



Titling and Graphics

In signal production, usually an international signal is generated with titles in English to provide all channels with a general and uniform heading service. This advantage in production becomes an inconvenience: one is the impossibility of generating differentiated titles because they would collide with those from the original signal when being superimposed on the same image. Filing of the image in the general chain file is another inconvenience since images are already dirty; the value of the image is reduced because the type of production and its possibilities are limited.

To solve the image titling problem, it is usually looked at from different points of view.

1. Signal Production: Whoever produces the signal usually sends two different satellite signals: clean signal and titled signal in international language, each of the chains is free to choose one signal or the other. This alternative has the disadvantage of a cost

Figure 5. Contribution and program broadcasting

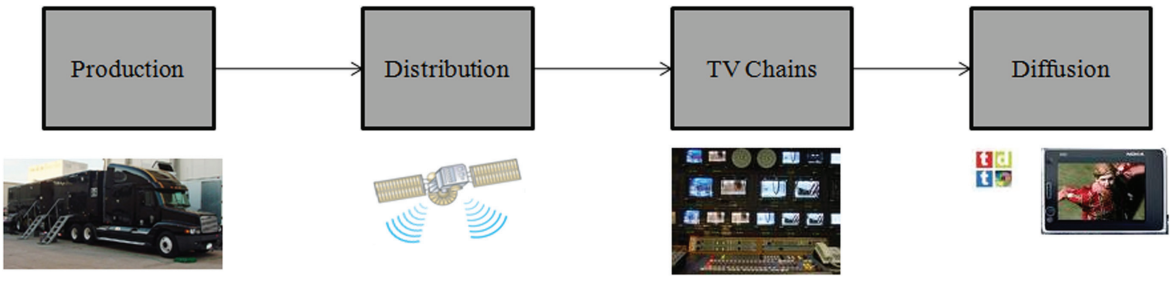


Figure 6. Playout control room (courtesy of Antena 3 de Televisión)

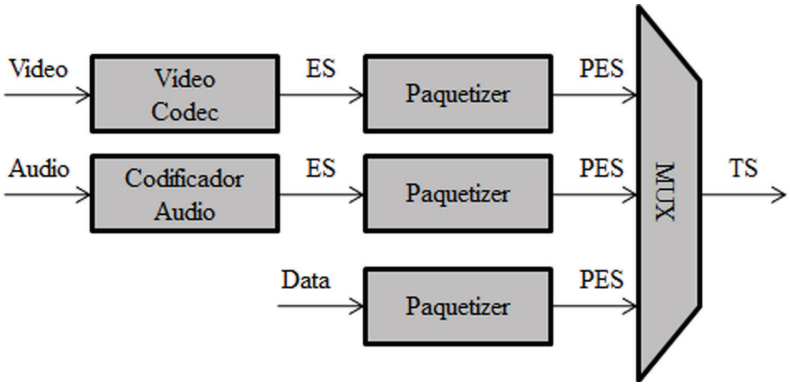
increase from the renting of another channel for signal distribution.

2. Event Broadcasting: In each country, owners of diffusion rights of an event, packet the video signal for transmission with their programmes. The form of packeting differs from the importance which is given to an event so that specific content can be created in each country. This way a range of possibilities exists from coverage with their own cameras in the stadium which are mixed with the general production, to the simple rebound of the contribution signal to diffusion without adding anything intermediary. Each of these possibilities has its advantages and disadvantages with its increases in associated costs and in general headings are usually poorer than international broadcasting.
3. Titling Production: Graphics are made in stations by templates; these templates have a fixed content and another variable. Fixed information refers to common elements which are in the same type of title, which are usually one or sequences of TGA's with the key information necessary so that the mixer can incrust the title into the video. The variable part can be an image (static or dynamic) or a text with the classical characteristics of text as far as font, size, etc.

The work process for titling of an event goes from enumeration all the templates types to be used, the creation of common elements of the titles, and the creation of spaces where the variable data of the models will be placed, characteristics and types of content (e.g. text, images, etc.).

Before the event begins, titles are prepared according to templates and stored on pages or sites to be called from the control terminal where the signal is generated. During the event broadcasting, data is updated and new titles are generated in a dynamic way on pages for emission.

Figure 7. Multiplexing of a program on a transport



New Ways of Broadcasting

For analog broadcasting, this adaptation is trivial and has been in use for a long period of time, the problem occurs when it is necessary to adapt content to each of the different technologies. If adaptation is only image and sound, it is still simple, but the characteristics which each of the systems provides are not taken advantage of. In the case of digital television, information will need to be provided to feed programs in MHP (Multimedia Home Platform), in the case of the web, the program will need additional data to exploit the advantages which it allows, and similarly for cable, mobiles or future technologies.

To fill these gaps, chains create departments to feed content to these new broadcasting formats and/or adapt their computer systems to select data they need from the production sources themselves. Production sources do not always provide this data and if they do, they are in varying formats, using different communication channels for each event. Channels have to adapt their equipment and communications in each program or event which need this type of data in such a way that they must continuously develop interfaces for content adaptation. These adaptation jobs are carried out by each of the channels, investing in jobs with limited or no return.

MPEG 2 Transport Stream

Despite the different encoding formats that have appeared on the market, the most accepted video transmission format for the contribution, distribution and broadcasting of professional quality video signals remains the standard MPEG2(ISO/IEC, 2000).

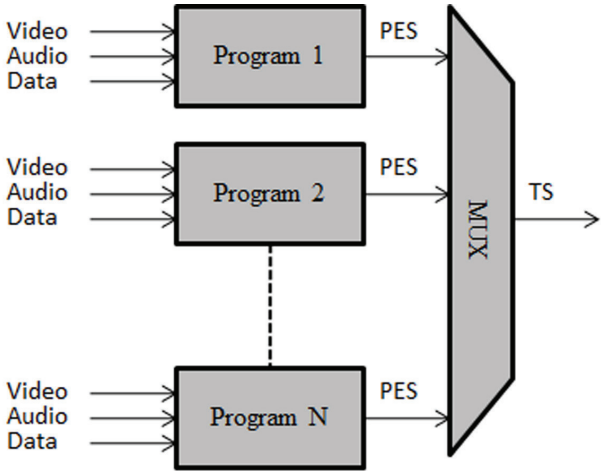
In this standard two types of formats are specified, i.e. the transport stream and the program stream. The first is used for transmission because of its greater robustness concerning noises in the channel and the second is used for production in environments with low error rates.

The various errors that may occur during transmission of the transport stream are corrected at reception so as to minimize the effects that may occur in the image. Multiple jobs and methods have been developed for this purpose.

A program consists of several types of data (video, audio, data) which are encapsulated into Elementary Streams (ES) and multiplexed into a data stream. Each of these elementary streams is packaged into Packetized Elementary Stream (PES). In order to keep synchronization between the audio and video data, time stamps are inserted for a correct decoding and displaying of images and sound.

Figure 7 shows the multiplexing of a video signal, audio signal and other data associated

Figure 8. N programs multiplexed on a transport stream



with a program stream. In each program stream multiple video, audio or data channels may be associated. The speed of the elementary stream may vary depending on the quality required for the images. To contribute to a central location, the speed can vary from 8 to 50 Mbps. The nature of the images and the transmission purposes will determine the selected quality. To broadcast the signal 2.5 to 7 Mbps is generally used.

For monitoring distribution channels, either DVB or VoIP, the channels can be compressed to higher rates (e.g. of 4 to 8 Mbps) and several programs can be multiplexed as a single transport stream as shown in Figure 8.

In either case, previous data is accessible from the transport stream which is, thus, generated at the source with the application of inverse operations from the transport stream.

File Transfer

In order to link video between two points, data links are often used unidirectionally to transmit the charge transport stream. The corresponding demultiplexer is installed at the reception.

To transfer over unidirectional links, there are various file transfer protocols based on retransmission patterns of the same file. The Reliable Multicast Transport (RMT) IETF Working Group deals with standardizing reliable multicast one to many transport protocols.

In (Neumann, 2005), a study discusses three types of transfer protocols that can be used in unidirectional networks. The Asynchronous Layered Coding (ALC) (M. Luby, 2002) does not require any feedback from the receivers and the data are encoded using FEC codes. Repetitions of the symbols shipment guarantee the integrity of the file at the expense of effective bandwidth loss.

The Nack Oriented Reliable Multicast (NORM) (B. Adamson, 2004) retransmits only the damaged parts from one of the receptors that send signals of Negative Acknowledgments (NACK) over damaged blocks.

The File Delivery over Unidirectional Transport (FLUTE) (T. Paila, 2004), based on ALC protocol, with the extension to be used in any type of transmission channel (unidirectional or not), offers metadata which complete the image signal itself (e.g. name file, codec, etc.).

MAIN FOCUS OF THE CHAPTER (ANALYSIS)

The spreading of new systems of broadcasting and distribution of multimedia content has had as a consequence a larger need for aggregation of data and metadata to traditionally based contents of video and audio supply. Broadcasters have to add value as data or interactive services to the classic programmes. Broadcasting chains of this type of channels have become overwhelmed by the quantity of resources, infrastructures and development needed for these channels to provide information; channels often lack knowledge about subjects they broadcast because production is performed externally. Knowledge of the material is passing to production companies who in fact fully know the topics of the programs.

When an event will be transmitted, producer companies usually send data or specify the data format with the communication link and parameters to use during the event. Broadcasting companies have to adapt and/or develop their IT and communication infrastructure in order to receive the data associated to the program itself. Data have to be transformed, filtered, processed and adapted for each technology. These processes increase the production cost for the events, and this events usually occurs during a short period of time (normally hours).

The creation of data and additional content to the program signal require a close coordination between producers and broadcasters, modification of channel systems, adaptation of the media and application vigilance during emission. These jobs increase production cost and are not normally undertaken in live retransmissions. Necessary conditions for these services to be offered to viewers pass from:

- Decrease cost of content production
- Decrease cost of system development
- Establish communications systems
- Ensure dissemination of this content during the event.

In order to avoid this kind of shortcomings, several recommendations and standards have been created to exchange metadata between production and distribution of stored programs. The problem lies in live programs, which in many of them, data is a very important part for understanding the event to be broadcasted. Producers sometimes offer data to channels but most often, channels are not able to face developments which are required, due to above all, uncertainty of the return in their investment. The solution to this problem includes reduction of implementation costs for development of services on these new platforms.

For this type of work, creation of a team composed of producers, chains, communication companies, viewer associations, etc. would be needed to define the needs of each.

Environment

In order to achieve the above mentioned objectives, the purpose of this work is based on three models: data, application and communications.

A. Data*:* Coordination between production and broadcasting can be avoided if data to be transferred among different agents is standardized; in such a way that each knows the format in which data will arrive at any time. This standardization could be done under any technology; the one suggested in this work is the use of XML documents for this transfer, so that creation of a metamodel would be necessary to include all possible services which can be offered among all parties. The choice of XML documents would be of great assistance when using the application.
B. Application*:* To avoid system modification for each event, the application would have the capacity to receive the metamodel which is

created for data exchange and also proposes the following characteristics:

- Data filtering, for cases in which channels do not want to receive the shower of data some kinds of events may generate.
- Processing and management of alarms, to determine which of the received data is more interesting and to use alarms which alert different types of events.
- Distribution to different broadcasting media, so that received and processed data can be shown on web, DVB-h, mobiles, etc.

C. Communications: The communications channel between the different parties should be conducted with the same medium, so that communications adaptation will not be necessary for any type of event.

Services

To be able to affront the data model which can serve producers as well as distribution chains, analysis of the type of services which can or usually are offered by producers is necessary.

A. Assistance to commentators: In certain events, commentators have screens with data at their desks which assist them during retransmission. These screens are usually video monitors in which data the organizers deem appropriate appear in a cyclical way. Also, they are usually terminals connected to a data network with a program which shows these data. Commentators must physically be in the stadium to be able to receive these data.

B. Graphics and titling: The program signal usually comes with heading in international language. To allow chains to be able to insert their own heading, a clean feed is distributed, so that TV channels can insert their own titles with graphics and language they are interested in (if they have the rights to do so).

C. Subtitling: For taped programs, as was seen in the above chapter, there is much redundant information, areas and processes when doing subtitling work. The model proposed for this application is classification, as in audio, of original and natural subtitles.

D. File: One of the discussions which are usually repetitive over time in TV channels revolves around the philosophy of the file to be implemented in each company. One of the aspects of these discussions is the filing of material with or without graphics, titled images are usually considered to be ¨dirty¨ but they contain information about test data, clean images are perfect for filing because of their ease of reuse, when the image is titled it is more complicated to remake another heading because there may be problems with composition among titles.

E. Advertising: This is the main return on the investment made in purchase of retransmission rights of events. Many of these events have strict regulations on spaces in which publicity can be broadcasted; this publicity may range from lengthy spaces to small headings inserted in the image. TV channels must decide in real time the moment they can insert their advertisement publicity as the event develops. To provide this service, delivery of a signal would be necessary to indicate the possibility of showing advertisements, their length and type of advertisement that can be included.

F. Education: In our society, e-learning is being used more and more by people who want to acquire different types of knowledge. Events of a minority nature have regulations which many times are unknown to viewers who are not used to these shows. A visualization of the rules as far as how a game is played can enrich content and provide comprehen-

sion. This delivery of rules can be made in a structured way, to be shown on a web page during internet emission or on screen when each of the rules is applied, when the user chooses.

Programs

In this section, the convenience or not of each of the above services will be analyzed. It will be necessary to see the type of programs which are usually shown live and associate them to the different services.

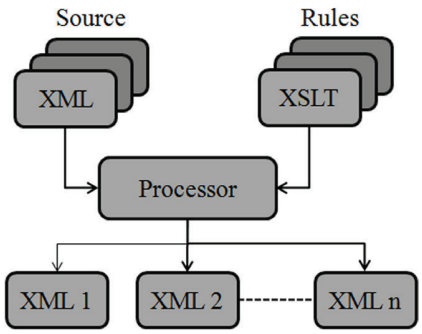
A. Sports: These are of the programs in which data are very important for the commentators as well as for graphic generation.
B. Live Music: Retransmission of music concerts is becoming more frequent, classical as well as modern. In the specific case of opera, most people do not understand the meaning of the songs or the plot. Subtitling song lyrics can assist a great deal in understanding opera.
C. Elections: They are of the most important events in politics. Data are generated by each organism. In Spain there are at least 23 elections every four years: European, national, Senate, 17 regional and local elections. Chains have video links with each electoral seat where results are read; chains can receive homogeneous information in the same video signal.

General Model

As has been put forward in previous chapters, the data delivery model between production companies and dissemination chains is made on the same video signal and is extensible to diffusion between users by DVB in its modes of satellite, terrestrial, mobiles or cable.

A. File transmission: For delivery of XML documents, the transmission model which is used must be taken into account:
   - Contribution. For delivery of information from a production centre to a receiving centre, it is a one on one communication. It is the typical case of delivery of generated data in a stadium to the International Broadcaster Centre (IBC) in Olympic Games. Because it is a one-few type of delivery, transmission will be by means of NORM (B. Adamson, 2004), since it has a good response for few receiving stations.
   - Distribution. For information delivery from one centre to many receivers. It is the type of one to many transmissions. A clear example might be delivery of the final Wimbledon tennis match in which there are large quantities of receiving stations that need information. For this case, the use of FLUTE (T. Paila, 2004) is proposed, with a return line by Internet, so that chains which do not receive information can ask for retransmission of data.
   - Broadcasting. In order to send files from a broadcasting chain to viewers, in this case the number of receivers increases considerably and poor radio electrical installations may influence poor reception of the files, so that redelivery petitions which are demanded on return lines may collapse transmission. The best adapted protocol is FLUTE without return line.
B. Distribution and content filtering: In production as well as reception, depending on the type of event, filtering or distribution of content may be necessary. Application of XML technologies simplifies these tasks since using XSLT documents they can be

Figure 9. Generic process for XML by XSLT



done in a simple way. XSLT is a language which transforms XML documents into other documents whether they are XML or other formats, see Figure 9.

Depending on the type of service, this conversion can be made at the source or at the destination. For the specific case of the Olympic Games and data distribution in each channel in the IBC, this transformation is made at the signal distribution to each channel. For the case of a channel that wishes to send content to different distribution media, this filter can be made at each channel, sending data to each broadcasting channel.

XSLT has the necessary functions to be able to manage complex transformation requirements and provide great flexibility to the system since exit data, as well as their configuration can be modified in a simple way only by changing the XSLT document, with the need to recompile the program since the document is read in execution time.

C. *Communications:* The medium proposed in this work is the use of the same video channel where image and sound is received for transfer of these data. This proposal is based above all on synchronization of data with image and audio, being the same physical medium, data will pass through on the same way, so that synchronization will occur naturally. If it were sent otherwise, synchronization would be necessary by insertion of common time codes. This solution would require the slowing of material which arrives before, if data arrive before, the slowing is simple, the problem occurs when video arrives before because this causes serious inconveniences for emission. The MPEG2 TS, is used not only to carry compressed images in MPEG2 but also for other types of formats such as MPEG4 or JPEG2000 *(S. Narasimhan, 2009)*, this is being studied by the European Broadcaster Union (EBU) for its use in professional distribution links.

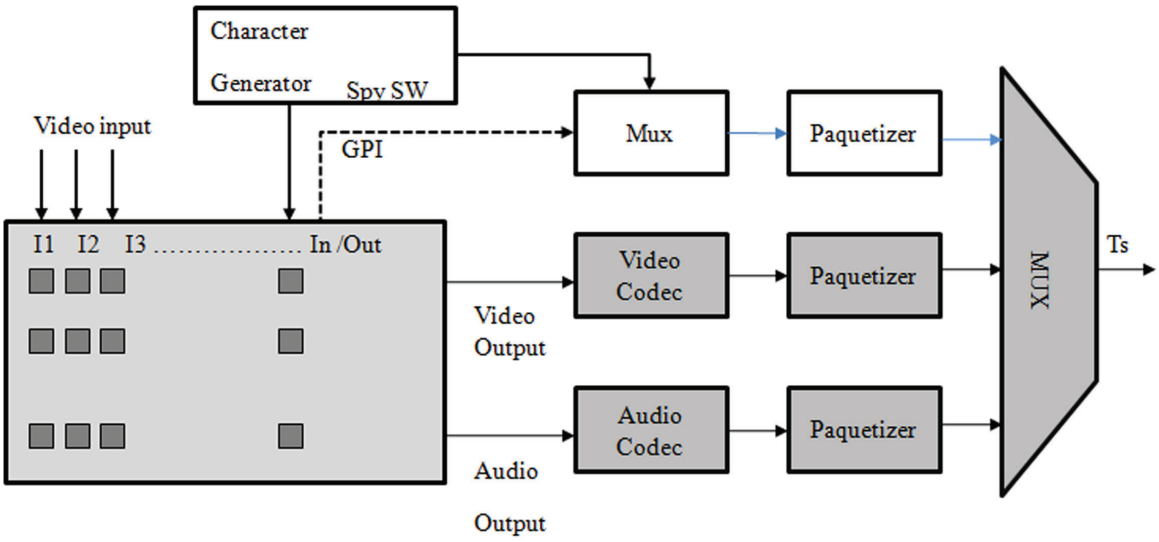
Titling

Titling is an example of service. For remote form heading, production data generation and extraction will be needed; its delivery and production in the remote position (J. Martínez Barbero, 2009).

A. Data extraction: There are two types of installations, master and slave. As can be seen in Figure 10 corresponding to the master, the mixer consists of 1 to n entrances with its corresponding signal entrances (10 ..In) and an exit of Gpi's (On). The system consists of spy software in charge of watching operations which are conducted in the title station, the data will be: the label model next to text, pages which are prepared for broadcasting next to the page which is at the titling exit.

In the figure, the classical installation of the mixer of a production control can be observed. The video entrances enter to the mixer to choose one source or another in the exit channel. Titling is completed on other independent equipment which acts as an entry source and when one wants to insert a heading, this signal is mixed with the exit at each moment. The GPI signal associated with titling must be taken into account; this signal is activated when the heading is shown in the exit.

Figure 10. Titling and mixing connections



The blue part of Figure 7 is the added components to the installation. The system consists of spy software in charge of watching operations which are made in the titling station, the data will be: the heading model next to its text, pages which are prepared for emission next to the page which is at the titling exit. On the other hand, detection will be needed every time the title to emission is clicked on by the GPI's detector, each time this signal is set to one, the trigger detector sends an impulse to indicate the mixer going on air. The different data are multiplexed on the exit transport stream together with the video without heading and international audio for its distribution to different televisions.

In the broadcasters' installations, the signal must be multiplexed to extract different signals and data. The installation will be an opposite replica of the base station. By the remote control of the titler, the same commands of heading generation and presentation are made as at the origin. The GPI signal is regenerated again to order the mixer to put the title on air each time that a heading is clicked on in the mixer at the origin.

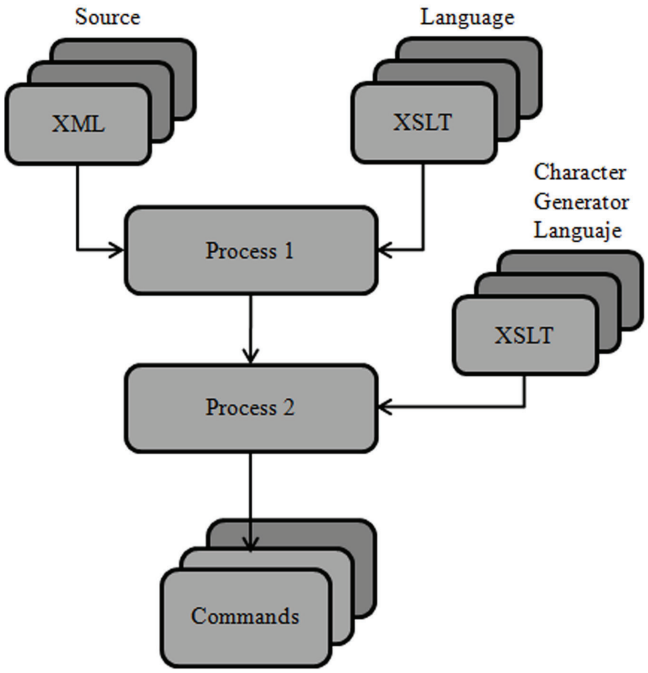
B. Distribution and content conversion: Files to be transmitted will have an XML structure, for better adaptation of different results to the titling device, a stream of data will be obtained from union of the different files which will be absorbed on the video stream.

At the destination station, the system must process the content which arrives together with the image, for delivery of commands to titling stations. Two types of translation will be necessary: adaptation of messages to language, possibly including personalization of publicity and adaptation of commands to the titling machine, since the destination broadcaster may have equipment with a different protocol to that producing the signal.

Before retransmission of each event, a distribution of the texts will be necessary that are presumably going to be used so that in each television translations can be made of each item and generating XSLT's for language and for destination equipment commands.

As shown in Figure 11, the XML entrance generates a continuous stream of data by XML files. To give the system more modularity, it is divided into two processes, translation to the

Figure 11. Language and equipment translation steps



country's language and the corresponding translation to equipment commands. For each type of message which arrives from event production, there is an associated XSLT which contains message translations. Once conversion of language is completed, conversion is carried out of specific commands for the type of equipment required; there will also be an XSLT for each type of command which will be run.

The problem: In sporting event transmissions of international significance, broadcasting in each country is carried out by the owner of the rights for that particular country. The output signal (program signal) in the original production center normally contains the graphic elements presented in the language considered the most international: English.

The problem created by this "dirty" signal in the different broadcasters is double: On one hand, title adaptation produces the superposition of different graphics on a same image. On the other hand, those titles will remain in the channel's historical files.

If we send the data into the MPEG2 stream we solve both problems.

C. Production side: There will be two types of installations: Master and Slave installations. As Master figure shows in Figure7, the mixer consists of 1 to n inputs (10...In) and a GPI's (On) output (General Purpose Interface).

The system consists of spy software in charge of watching over the operations performed in the titling station. The type of data generated will consist of: The model of title together with its text, the pages being prepared for their broadcast and the page located at the character generator output.

On the other hand it will be necessary to detect every time the character generator for broadcast is "punctured" by means of the GPI's detector. Each time this signal is set to 1, the triggering detector sends an impulse to indicate the mixer has been

Figure 12. Delivery of video, audio, and data in a transport stream over satellite link

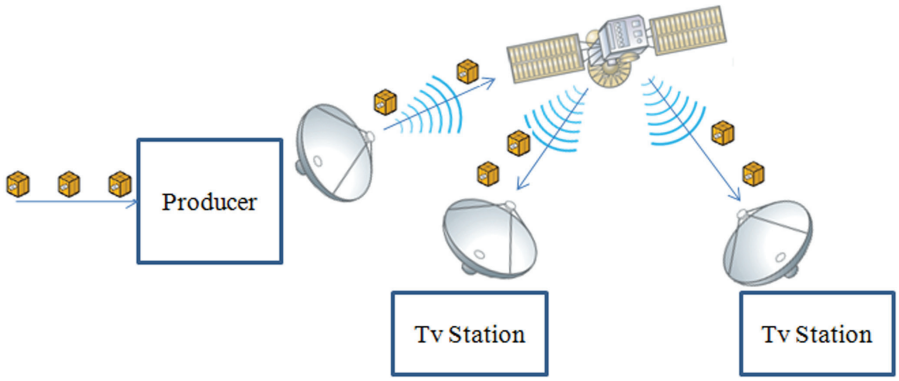
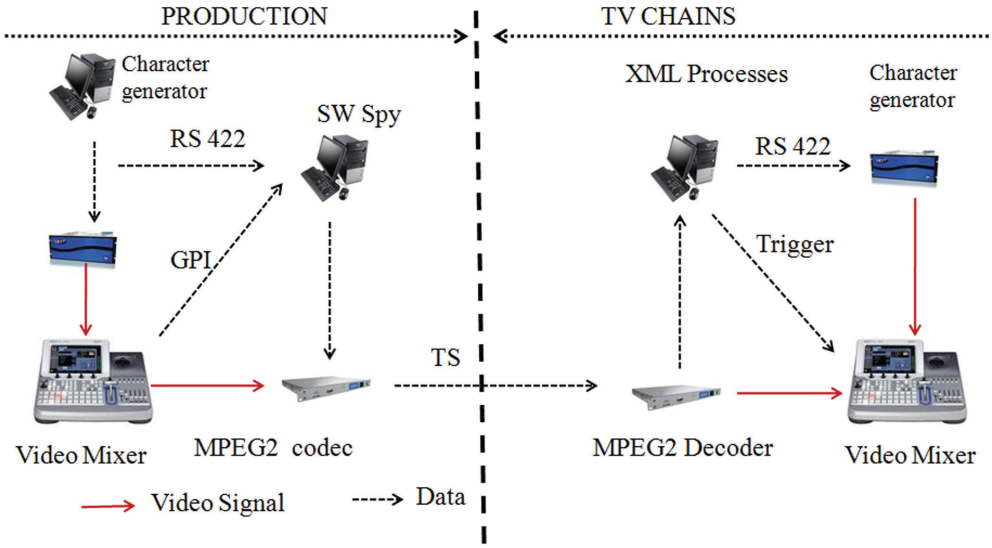


Figure 13. Data flow between production and TV channels for remote titling



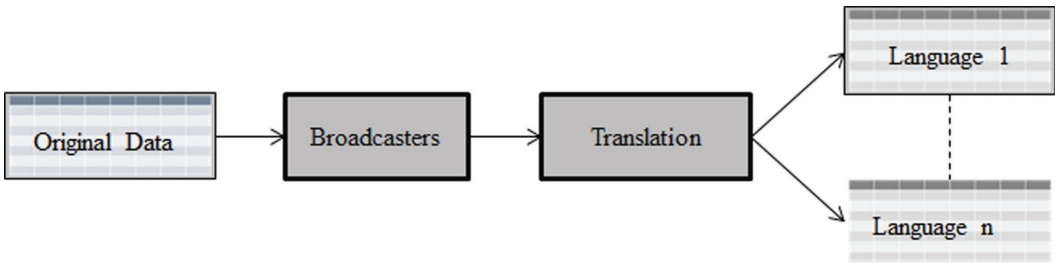
set to air. The various data are multiplexed over the output transport stream, together with the video without titling and the international audio, for its distribution to the different televisions. The transport stream is uplinked to the satellite for its distribution as in Figure 12 to the different broadcasters.

Within the broadcasters' facilities, the signal must be multiplexed to obtain the different signals and data. By means of the character generator's remote control, they are being executed the same generation and title-display commands as in the origin. As we can see in Figure 13, the GPI signal regenerates again to command the mixer to puncture the character generator, every time that, in its origin, a title is punctured in the mixer.

Subtitling

Live events: Two types of tasks are presented: preproduction and playout. In preproduction, a distribution of files is carried out with identifi-

Figure 14. File distribution workflow



Box 4.

```
<body region=”subtitleArea”>
  <div>
    <p xml:id=”subt1” begin=”25s” end=”27s” duration=”2.0s” Hello Figaro
      </p></div>
<p xml:id=”subtitle2” begin=”30s” end=”32s” duration=”2.0s”>
       Are you alone?
    </p>
</body>
```

The translated file is shown in Box 5.

Box 5.

```
<body region=”subtitleArea”>
  <div>
       <p xml:id=”subt1” begin=”25s” end=”27s” duration=”2.0s”
         Hola Fígaro
      </p></div>
<p xml:id=”subtitle2” begin=”30s” end=”32s” duration=”2.0s”>
       ¿Estás solo?
    </p>
</body>
```

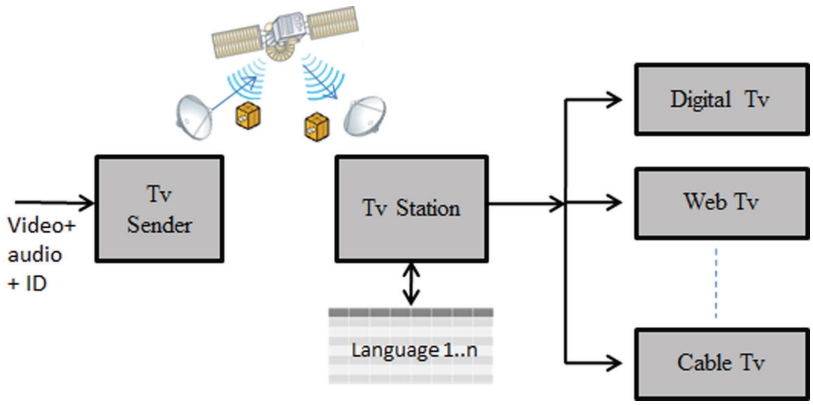
cation of each heading while in emission only the identifier absorbed in the video signal is sent (Barbero & Pérez, 2009).

- Preproduction: Files are distributed to chains, which carry out translation of each of the subtitles in the languages desired, information as far as entry time for each subtitle is only one reference, never a real data, since it is a live program, this data can vary. The DFXP file contains all necessary information; with the exception that fields begin and end is purely tentative being a live program, if time of duration exposition is more real. The workflow can see in Figure 14.

An example of the distribution file is shown in Box 4.

- Playout: During emission the text identifier is sent which is to be shown in the PES

Figure 15. Identification transmission



Box 6.

```
<body region="subtitleArea">
  <div>
        <p xml:id="subt1" begin="28s" end="30s" duration="2.0s"
          Hola Fígaro
      </p></div>
<p xml:id="subtitle2" begin="32s" end="34s" duration="2.0s">
       ¿Estás solo?
    </p>
</body>
```

packet of data in the MPEG2 TS ass it can see in Figure 15. Each packet can be sent many times by FLUTE protocol to avoid transmission errors. Delay in audio or video is usually quite troublesome in such a way that de-synchronization between audio-video is produced, this margin is usually 200mS, in the case of headings, this delay is not as strict and almost a second can be waited without the viewer noticing, so that the identifier can be sent many times using this protocol.

When an identifier reaches the television channel, a simple search is conducted of the identifier in the translated file, selecting information to incorporate it as a subtitle in the broadcasting.

On a parallel, a DFXP file is generated with the synchronized information of audio, video and data and its later filing for possible future broadcasting.

An example of XML which is sent in broadcasting will be

```
<div>
      <p xml:id="subt1"
   </p></div>
```

Showing the text "Estás solo?" for another two seconds.

The file being stored for file will have real data synchronized with the time code of the video (see Box 6).

Rest of Services

To assist commentators, each of the channels can prepare its own XSLT to receive information they consider to be most appropriate.

Before saving file material, the filter can be made in the same buildings of the TV chains; selecting data they want to store and which each company believes useful for later broadcasting or viewing.

Filtering of entry data flow can be made the same way for its distribution to other media so they feed each of the installed platforms without need to create specific content for each of them, in the same way education can be carried out with possible levels of aid.

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

In this work an effort has been made to lower development costs of broadcasting companies in audiovisual content, based on delivery of data and metadata associated with live programs by video lines which are necessary for program broadcasting. This lowering of cost not only benefits broadcasting companies but also users who can benefit from the advantages they will have by being able to access data and assistance that the producer of the program has. On the other hand, the advantages have been shown of the possibility that the video itself carries incorporated data, advantages in synchronization, filing, program reuse etc.

There is a long road to development, there are still more services needed, documentary automatic systems from the metadata which are carried by video, alerting systems, automatic production systems which select video lines from data which are sent along them and to be redefined by user and artistic, etc.

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